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APPLIED REMOTE SENSING PROGRAM (ARSP)

Office of Arid Lands Studies
University of Arizona
Tucson, Arizona 85721

Second Progress Report of Projects and Activities of ARSP for 1976 - 1977

(NASA-CR-149588) APPLIED REMOTE SENSING PROGRAM (ARSP) Progress Report, 1 Sep. - 30 Nov. 1976 (Arizona Univ., Tucson.) 26 p HC A03/MF A01 CSCL 08F

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Progress Report to

National Aeronautics and Space Administration
Office of University Affairs
Washington, D.C. 20546

For the Period
1 September 76 to 30 November 76
Under NASA Grant NGL 03-002-313

In cooperation with local, regional, state, and federal agencies within the State of Arizona

INTRODUCTION

This progress report covers work performed by ARSP during the three months September 76 - November 76. Three new projects have been initiated, and six continue as planned.

CONTINUING PROJECTS

AWC/SCS Water Diversion Structure Project

ARSP has completed research on and is preparing the final report for Phase II of the Arizona Water Commission-Soil Conservation Service project to assess the impact of water impoundments and diversion structures on vegetation in southern Arizona. The purpose of Phase II is to determine whether the structures are responsible for differences between upslope and downslope vegetation cover found in Phase I of the study and to identify reasons for differences in the amount of vegetation change produced by different structures.

The Soil Conservation Service has indicated that with the completion of this second phase they will change design specifications on certain types of diversion structures in order to lessen the deleterious impact of the structures on the downstream riparian habitat.

Vegetation maps were made from Arizona Highway Department and U.S. Army Map Service aerial photography predating

construction of the structures. Vegetation cover statistics generated from these maps were compared to recent vegetation statistics of the structures. This comparison helped ARSP determine whether or not the structures have had an impact on surrounding vegetation.

It appears that the primary impact of the structures is on riparian vegetation downslope from the structures. Riparian vegetation upslope from the structure and interfluve vegetation (occurring on both sides) is little-affected by the diversions.

The Soil Conservation Service recently performed a soil survey to be used in this project. Areas adjacent to three of the six structures were mapped. The other three structures were mapped during earlier soil surveys.

ARSP also determined runoff characteristics for the watersheds associated with the structures. Comparisons of watershed characteristics associated with each structure will help in evaluating why there is a greater vegetation change associated with some structures than with others.

Frequently, diversion structures are built near the geomorphic boundary between bajada and floodplain, where there are natural changes in vegetation and soils. Therefore, a comparison of only upslope and downslope vegetation statistics does not explain whether the vegetation differences were diversion-caused or due to natural differences caused by the landforms.

Phase II research included a "before-after" photo comparison utilizing low-altitude imagery taken of the diversion areas before construction and high-altitude U-2 imagery flown some years after construction. Also included was a study of watershed and soil parameters associated with each diversion and impoundment structure.

Of the six structures studied, two of the structures had little or no associated vegetation change. Neither of these structures impounded water however. In contrast, structures impounding water have a severe impact on vegetation especially vegetation downslope from the structures. Impact on vegetation is diminished when there are flow-through points built into the structures. Within the impoundment structure type, watershed yield appears to be an important variable in determining the amount of vegetation change produced.

Tucson Thermal Scan Project

A program to develop thermal scan techniques for monitoring heating and cooling losses in Tucson homes, neighborhoods, and industrial and commercial structures was initiated in the last quarter by the ARSP with the Energy Program Office, Arizona Office of Economic Planning and Development (OEPAD), the state planning agency.

The heating and cooling of buildings requires energy,

usually an inefficient energy-consuming process. According to the U.S. National Bureau of Standards, buildings consume about one-third of all our energy. The ARSP/OEPAD thermal scan project is monitoring and recording heat loss in the homes, businesses, and public buildings within the Tucson metropolitan area. The project results will be used by OEPAD to urge homeowners to make decisions on new insulation, roof repairs, building design and energy conservation measures.

This investigation of applications of thermal infrared (TIR) data to urban energy conservation is entering its final stages. The major tasks completed to date include: preflight planning/ground surveillance, image enhancement, negative/thermogram processing, thermogram cataloging/display, and a land use analysis of the Tucson study area.

The major tasks currently underway include: a manual on thermal infrared sensing, thermal mosaics of the OEPAD study area and visual displays depicting heat loss in differing structural types. The latter are being used to illustrate heat loss characteristics to decision makers in both the private and public sector. Visual analysis of heat loss problems in commercial buildings, schools, etc. will be used to encourage action on new insulation, roof repairs, etc.

Meetings with Arizona utility companies/OEPAD are being scheduled to discuss the applications of TIR in the design

of consumer oriented energy conservation programs. In the event the Utilities decide to utilize thermal IR data the Applied Remote Sensing Program and OEPAD are prepared to play an integral part in their efforts to assist homeowners and public officials make decisions resulting in more efficient energy use.

Petrified Forest National Park Project

Phase I and II of the Petrified Forest National Park resource inventory project conducted by ARSP in cooperation with the National Park Service has been completed.

Phase I of the project which was totally funded by the NPS was the development of an annotated bibliography of the PFNP vegetation including its history and changes. Additional work requested by the NPS will include a narrative of historical changes of vegetation within the park and the cultural history of northern Arizona.

Phase II was the construction of vegetation maps. The vegetation of the Petrified Forest National Park was mapped by using the dominant or indicator plant species to delineate vegetation boundaries and to form vegetation associations. Natural color, 1:24,000, aerial photographs were the bases for interpretation and delineation. These delineations were then transferred to orthophotoquads, also at 1:24,000, to insure the planimetric accuracy of the final maps. Extensive field work aided in reducing mechanical and human errors in the final production of the maps.

The vegetation associations were classified by modifying the computer compatible system designed by Charles E. Poulton[1] of Oregon State University. This system is similar to the one David Brown and Charles Lowe[2] designed for classifying Arizona's natural vegetation. The Poulton classification system is based solely upon the vegetation and floristics as observed in the field. In contrast to this approach, the Brown and Lowe system refers to potential vegetation as controlled by climatic regimes.

The vegetation maps will be used for the construction of the management proposals. The maps give an accurate assessment of the vegetation that comes in close contact with human activity and of the location of the especially delicate ecosystems.

There will also be a section of the report dealing with vegetation management recommendations. These recommendations will be instated by the Park personnel to insure that the vegetation will remain in a natural state. The NPS wishes the vegetation to remain in a natural state to allow scientific studies to ascertain the effects of grazing and human pressure on the natural vegetation. When

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[1]Pettinger, L.R./Poulton, C.E./et al. 1970. The application of high altitude photography for vegetational Resource inventories in southeastern Arizona, University of California, Forestry Remote Sensing Laboratory. 147p.

[2]Brown, David E./Lowe, C.H. 1974, The Arizona System for Natural and Potential Vegetation-Illustrated summary through the fifth digit for the North American Southwest. Journal of the Arizona Academy of Science, Volume 9, Supplement 3, 7p.

these studies are completed appropriate steps will be taken by the NPS to insure that visitors to the Park will not endanger fragile ecosystems. The rerouting of foot and vehicular traffic and the closure of certain areas of the Park will insure the preservation of these areas.

Accelerated erosion, started in the late 1800's has drastically altered the landscape in several areas of the Park. The management recommendations, in conjunction with the vegetation maps, are being used to evaluate proposals to end this erosion.

Three proposals concerned with erosion are:

1. Selected areas of the Park, with less than 25% ground cover, would be seeded to increase ground cover in an attempt to halt erosion processes.
2. Shrub and grass areas of the Park, with more than 25% ground cover, would be burned in an attempt to decrease shrub density and increase grass cover and dispersion.
3. The Tamarisk eradication program would be reinstated using techniques proposed in the report. The eradication of Tamarisk would stop the entrenchment and channelling of the streams allowing development of broad flood-plains which would greatly reduce stream flow

rates. The slower moving streams will not carry such a high sediment load thus reducing the erosion processes and lowering the danger of flash flooding.

Bureau of Land Management Rangeland Vegetation Project

The Safford Bureau of Land Management (BLM) Rangeland Vegetation Project was initiated in February, 1976 to assist the Safford District Office in meeting a requirement for the preparation of environmental impact statements.

The BLM will use the products provided to determine grazing allotments in the Safford District. The BLM leases its land to private interests for the production of cattle. A grazing allotment is a statement indicating how many cattle can utilize a specified area. Without adequate information the rangeland is either underused or overused and deteriorates. In the Safford District, the latter situation has prevailed. The information we provided will enable the BLM to make proper grazing allotment decisions. The BLM has been mandated with the task of providing an Environmental Impact Statement for its Safford District. Our products will be directly incorporated into that statement to be used to determine future District activity.

ARSP will provide the Safford office with a map of existing vegetation designated according to BLM standards and supplemental information on relative dominance of the

different species for an area of approximately 1½ million acres. Due to both time constraints and the small scale imagery (1:120,000) many of the plant communities were combined as vegetation complexes.

Most of the acquired imagery is U-2 high altitude color infrared and natural color enlarged to a scale of approximately 1:62,500. In one area where U-2 imagery was not available, a Skylab photograph was enlarged, and proved adequate for the mapping when coupled with intensive ground verification.

The Safford Bureau of Land Management Rangeland Vegetation Project is nearing completion. The 1:250,000 general base map is finished and presently in use by the BLM Environmental Impact Statement (EIS) Committee. All field work, verification by Safford office personnel and draft maps at the 1:63,360 scale are completed and presently being drafted in final form. Some delay on these larger scale maps resulted from a change made to accommodate new needs of the BLM.

In addition to use by the BLM for rangeland evaluation, the State Game and Fish Department has used our projects in assessing wildlife habitat and densities for the EIS. For further dissemination of these products, which amount to the most detailed vegetation maps available for over 1.5 million acres in SE Arizona, ARSP is planning to publish

a map series which will be available to the public. Attached is a reduced example of one of these maps. We have also profited considerably from this experience in large scale mapping of large areas and have greatly refined our methodologies for our current inventory of Pima County. The attached letter from the BLM supports the project.

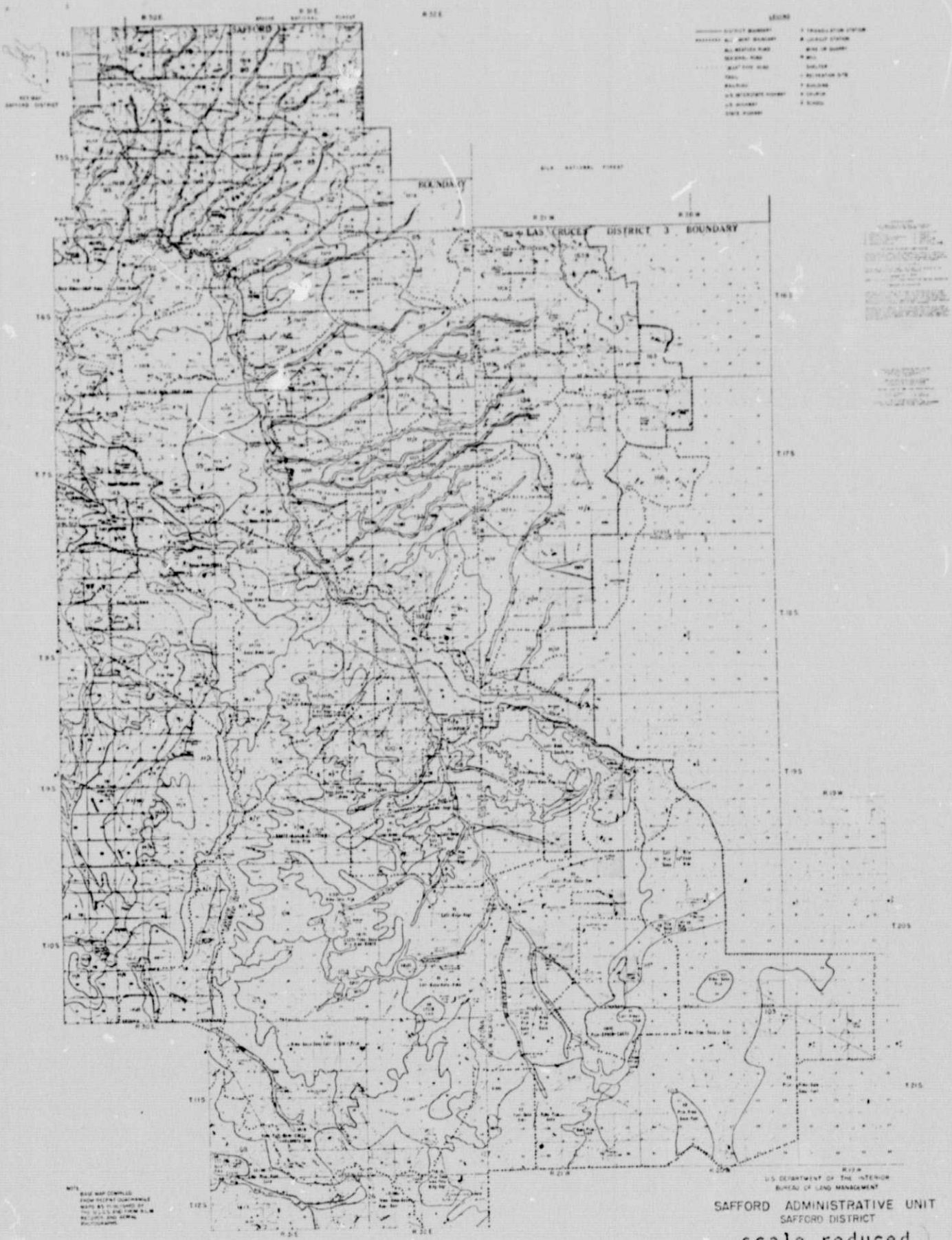
This project was a cost sharing agreement with the BLM contributing $2500 and flight time for field verification.

City of Winslow Flood Hazard Project

The Navajo County Board of Supervisors has contracted with ARSP to undertake a large-scale flood hazard mapping project adjacent to the city of Winslow. The 14 square mile area in question is situated between the current urbanized portion of Winslow and the Little Colorado River. Arizona Highway Department aerial photographs at a scale of 1:7,200 are being used in the project.

The Little Colorado River has had a history of flooding in the Winslow area. The project area was flooded in 1973 and the city itself was partially flooded in 1968. Navajo County wants to ensure by strict zoning ordinances that if housing is allowed in the flood prone areas that construction designs will raise the foundations above the flood level.

A Kelsh Plotter was used to delineate topographic contour lines having a two foot interval. This technique will augment techniques already developed by ARSP for flood hazard mapping.



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IN REPLY REFER TO

1791

United States Department of the Interior

BUREAU OF LAND MANAGEMENT

District Office
1707 Thatcher Boulevard
Safford, Arizona 85546

November 22, 1976

Dr. David Mouat
Attn: Mr. Dean Treadwell
Applied Remote Sensing Program
Office of Arid Land Studies
University of Arizona
Tucson, Arizona 85721

Dear Dr. Mouat:

The vegetation type map compiled by your office for us is of excellent quality and is being used for the San Simon-Gila Grazing Environmental Impact Statement which is currently being written.

The Safford District, Bureau of Land Management, had no comprehensive vegetative type map covering the entire grazing district or that was current. Your product gave us a complete type map that is most beneficial to us. It saved us several thousand dollars in man-months at a time when we didn't have personnel to spare to do the job.

If you hadn't prepared the type map, we would have either had to revise older, often obsolete, data or tried to release enough personnel to do the job. This might have caused us to fail to meet the deadline for our grazing EIS.

The vegetative type map will be used to provide basic inventory data for our grazing EIS. This map will also be used as a basis for a range survey to determine the livestock carrying capacity of individual allotments. Having this type map before range surveying begins will greatly reduce field time and increase the accuracy of the range survey.

We felt that Dean Treadwell, Jeff Conn and David Mouat did an excellent job for us.

Sincerely yours,

Robert E. Jones
Acting District Manager

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

Completion date for this project is December 1976. Until the project is done, the Navajo County Board of Supervisors has ceased giving any building permits for construction on the floodplain. After they receive the maps and supporting information, the Board of Supervisors will initiate a policy decision concerning which areas of the floodplain will be banned from any construction. Construction on the remaining floodplain land will be required to be elevated above the projected 100 year heights. These buildings will also be required to use special material that will better withstand flood waters.

Pima Association of Governments and Papago Tribal Utility Authority Project

ARSP has entered into an agreement with both Pima Association of Governments (PAG) and Papago Tribal Utility Authority (PTUA) to provide a detailed inventory of land use and specified natural resources for the entirity of Pima County and the Papago Indian Reservation, approximately 9000 square miles. The primary objective of this work is to serve as the base information for a 208 water quality management plan for Pima County.

ARSP will delineate and classify cultural land use and natural land cover, landforms and slope as primary information, i.e. from photointerpretation of U-2 positive transparencies and field verification. In addition, geologic and soils information will be extrapolated from collateral data, and enhanced from photo-interpretation and field work. All of this information will be incorporated into a fractional code characterizing each polygon mapped. The mapping scale is 1:62,500 and minimum polygon size has been designated as 10 acres for particularly important features, with the more common mapping unit being 160 acres or larger. To facilitate data transfer and planimetric accuracy, initial mapping is on reduced scale orthophotoquads. A corollary of this inventory is an attempt to locate commercially valuable sand and gravel deposits to help the Papago construction industry.

solicited input concerning needs of other local, state and federal agencies. We are currently discussing modifications of this project to meet specific needs of two National Parks and a small parcel of land under BLM jurisdiction in Pima County.

At this date, we are nearing completion of the first quarter of the project. All organizational aspects are operational, all imagery has been secured, training of personnel is completed and about 14% of the field work is completed. First products are due on 7 December 1976. These will include overlays for five or six 15' minute quadrangles, and a first draft of the procedural manual. Work in the next quarter will be continued mapping and field verification, documentation of collateral data sources and description of legend categories.

The successful completion of our 208 Program should result in a rational, region wide program to obviate and mitigate water quality and water supply problems which, in our opinion, presently pose a major threat to the future economic viability and quality of living of the Tucson metropolitan area. Specific results anticipated from this program include:

- restructuring of local and regional water resource policy,
- development of a comprehensive and coordinated action oriented program to address both water quality and water resource problems,

The final products will be a series of blackline on mylar overlays for each 15' USGS topographic quadrangle. ARSP will provide a detailed manual and documented description of each legend category delineated. Because this large scale mapping of such a large area is not a common undertaking, considerable effort is being made on this documentation and a refinement of methodologies in general.

This inventory is a cost-sharing project between PAG ($15,000), PTUA ($20,000), and ARSP ($10,000), with some additional funds ($7,000) from an Indian Development grant (NADSAT). Most of the NASA contribution was intended as salaries for supervisory personnel, imagery and equipment. In addition to seven part time graduate students hired for the work, capital expenditures have been invested in a new zoom stereoscope, light tables, drafting tables and other equipment, and an additional 450 square feet of space has been acquired.

ARSP considers a project of this magnitude as an excellent opportunity to expand our capabilities and contacts with other user agencies. Without doubt, the detailed information being collected should be disseminated to any potential user. The USDA Soil Conservation Service is also cooperating in an effort to update the very general 1:500,000 map which is the only information available for most of the county. In the latest ARSP Newsletter, we actively

- restructuring of governmental agencies and agency operating procedures.

The attached letter from PAG 208 director Jack Bale signifies the importance of the project to PAG.

PIMA ASSOCIATION OF GOVERNMENTS
405 TRANSAMERICA BUILDING
TUCSON, ARIZONA 85701
792-1093

PAG-208 Project

November 22, 1976

Dr. David Mouat
University of Arizona
Office of Arid Lands
Tucson, Arizona 85721

Dear Dr. Mouat:

Areawide Waste Treatment Management Planning, under Section 208 of the 1972 amendments to the Federal Water Pollution Control Act, is a program which stresses comprehensive regional water quality planning involving local governments. As you know, the Tucson/Pima County SMSA 208 Program has requested the Office of Arid Lands Studies, at the University of Arizona to assist in the data gathering chores for this two year planning program which encompasses an area in excess of 9,000 square miles. Our needs are for spatially accurate land use and land resources data which, as you have pointed out, can be produced in a timely and inexpensive manner through the application of remote sensing technology. In addition, the methodology and technology utilized can be transferred to our agency and can be made available for monitoring and updating activities associated with the continuing water quality planning process in our area.

The successful completion of our 208 Program should result in a rational, region-wide program to obviate and mitigate water quality and water supply problems which, in our opinion, presently pose a major threat to the future economic viability and livability of the Tucson metropolitan area. Specific results anticipated from this program include:

- restructuring of local and regional water resource policy,
- development of a comprehensive and coordinated action-oriented program to address both water quality and water resource problems,
- restructuring of governmental agencies and agency operating procedures.

We realize that the assistance of the Office of Arid Lands Studies will not in and of itself result in the above identified changes to the regional water resource management system; however, we have identified the use of remote sensing technology as a valuable and necessary tool which greatly enhances the potential for success of our program. Just and fair solutions to existing and potential water quality problems, as well as evaluation and monitoring of impacts resulting from the plan, will depend specifically upon the data and perspective provided by aerial imagery.

We view your involvement in this project as necessary and at this time wish to express our appreciation for the assistance and outstanding cooperation offered by the Office of Arid Lands Studies, of the University of Arizona, under the support of your NASA grant.

Sincerely,

Jack B. Bale
Project Director

JBB/ah

NOV 1976
RECEIVED
OFFICE OF
ARID LANDS
STUDIES

NEW PROJECTS

Gila River Land Use Survey

Responding to a July, 1976, resolution by the San Carlos Apache Tribal Council, the OALS Laboratory of Native Development, Systems Analysis and Applied Technology (NADSAT) has begun a comprehensive investigation into alternative water and land use systems for the tribe's segment of the Gila River Basin. This objective has been defined as the tribe's top priority in its Overall Economic Development Plan. Currently, only a small percentage of the tribal land and water resources within the Gila River Basin are being utilized.

One phase of the project plan will use current color aerial photography at a scale of 1:24,000 in conjunction with ground survey information to provide a precise delineation and categorization of present land use, and assist in the determination and delineation of potentially arable land via vegetation and soil analysis, and flood hazard potential.

The Applied Remote Sensing Program has been provided $6100.00 to determine imagery needs and produce overlay maps indicating 1) current land use, 2) potentially arable land classified by use type, and 3) flood hazard potential.

At this date, the aerial photography has been secured and preliminary ground verification has been completed. A specific decision emanating from this work will be the introduction of appropriate crops on the reservation which are compatible with the quality and quantity of water available. Currently, the Tribal water resources are underutilized, and hence agricultural losses are higher in an area already hit by 50% unemployment and low income.

Tumacacori Floral Inventory

The Tumacacori Floral Inventory and Floral Map Project was undertaken by ARSP at the request of the U.S. National Park Service, in October 1976. Tumacacori Mission National Monument needed a complete vascular floral inventory and a map indicating the exact location of all perennial plants. Mr. W.F. Steenbergh, the Park Service Research Biologist at the University of Arizona recommended ARSP because of our concurrent work at Petrified Forest National Park, the possibility of using aerial photography as a base map, and our staff of botanists hired for the Pima County Inventory. The project which is being funded in its entirety by the National Park Service for $1800 will last approximately one year.

The floral collection was started immediately and at this date is largely completed. Approximately 109 species were collected, identified and verified by the University

of Arizona herbarium. Final collecting will have to wait until the spring and summer of 1977 for the species of those seasons.

Because of the small size of the Monument, 15 acres, and the need to identify the locations of individual plants, exceptionally large scale imagery was required. ARSP contracted with a local aerial photography company to produce a black and white photograph at a scale of 1" = 20'. When planning the type of coverage, we also contacted the Western Archeological Center of the NPS concerning their potential use of the imagery.

The overflight was conducted in October, an optimal time for plant foliage, and the enlarged prints have been checked in the field for adequate detail and scale. Plans are tentative for making the plant location map, but this will probably be accomplished in the early spring, 1977.

Final products will consist of an overlay of the base photo keyed to species named and a complete list of the vascular flora, and will be completed prior to the 30 September 1977 deadline. Attached is a letter from Park Superintendent Joseph Sewell.

University of Arizona Water Use Inventory

ARSP has completed a land use inventory of the University of Arizona campus for the Division of Physical Resources and the Water Resources Research Center. These two university

United States Department of the Interior
NATIONAL PARK SERVICE
TUMACACORI NATIONAL MONUMENT
P. O. BOX 67
TUMACACORI, ARIZONA 85640

IN REPLY REFER TO:

N2215

November 16, 1976

Mr. B. Dean Treadwell
Research Assistant
Office of Arid Lands Studies
Applied Remote Sensing Program
845 No. Park
Tucson, Arizona 85719

Dear Dean:

I appreciate receiving an update of the progress of the floral inventory and mapping project for Tumacacori National Monument. We are pleased that so much has been accomplished in such a relatively short time.

This project which has been identified in the recently approved Natural and Cultural Resources Management Plan for the Monument will provide data which will assist in:

1. Knowing precisely what plant species are on the Monument grounds and their location. (Something which has never been done accurately nor comprehensively since it's establishment in 1908)

2. Application of this information to the establishment and perpetuation of the historic scene with the eventual removal of exotic species, and possible re-introduction of those which are native, especially grasses.

3. Providing future managers with an important resource information base in making succession comparisons in years to come.

In summary, we cannot continue to haphazardly manage a resource which has not been scientifically identified.

JOHNNY HORIZON '76
Let's Clean Up America For Our 200th Birthday

I will pursue the matter of partial payment upon completion of the mapping through the Southern Arizona Group office in Phoenix and inform you of their decision before the end of this month.

Sincerely yours,

Joseph L. Sewell
Superintendent

agencies are conducting a water use inventory to determine water usage and water waste production on campus. Data collected from this inventory will be used in developing various conservation and reuse possibilities.

ARSP's input into the project consisted of mapping the university area according to three main categories: vegetation cover, roof areas and paved or dirt areas. A detailed overlay of the campus was made using an aerial photograph at a scale of 1:1600. This land use overlay is being incorporated into the Water Resources Research Center studies in estimating campus water consumption. A copy of the map is attached.

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scale reduced
to 1:6,000

Prepared by Applied Remote Sensing Program
OALS, University of Arizona